



## ORIGINAL ARTICLE

# The Role of Climate Factors on Designing and Constructing Buildings (From Urbanization Architecture Approach)

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### ABSTRACT

*The role of various meteorological factors on civil operations and building construction is of high importance. Being aware of meteorological parameters of construction site including the amount and type of rainfall, temperature, humidity, direction and wind speed, detrimental environmental phenomena including heavy showers, heavy winds, local changeability, glacial times, heavy snow, etc. is essential before designing a building. It is quite obvious that considering these items especially extreme values would result in sustainability and strength of the building against possible regional climate events and also cause the fall of energy loss at the time of exploitation. Besides the importance of climate factors, knowledge and attention to weather condition and taking necessary measures and action at the time of building construction, the utmost adjustment and correspondence of project activities with the weather forecast would decrease the possible damages and loss. The most outstanding example is the care must be given to flood forecast for dam-building workshops on the way of rivers which would prevent mobile equipment loss and human death toll. This study attempts to consider long term climate data and the future of weather condition in order to highlight the major role of weather and climate knowledge in construction operations.*

**Key Words:** Meteorology, Climatology, Weather forecast, Weather and Climate Disasters

Received 23/10/2013 Accepted 30/11/2013

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### INTRODUCTION

The effect of meteorological factors on human constructions has long been considered so much so that in the traditional architecture and new civil engineering, this issue has been accounted for according to the available facilities and information. Considering climate factors registered based on long-term climate data is essential in designing and building construction in different locations so as to assimilate with the region's climate and minimize the potential adverse effects and also to optimize the climate potentials. There have been many studies on designing buildings consistent with climate among which we can refer to Najar Saligeh [1], Lashkari and Pourkhadam [2], Farajzadeh Asl and et al [2009], Tavousi [4] and Moshiri [5]. But the effect of all climate parameters on building design and civil operations has never been analyzed altogether briefly. This study attempts to refer to the most important climate factors affecting in the field and analyzed their roles.

Also, there has never been any study on the use of weather conditions in near future about the adjustment of civil operations especially on weather and climate disasters like flood, heavy rain and snowfall, heavy wind, etc. in any scientific papers. This study tries to deals briefly with this issue as well.

### CLIMATE FACTORS

There are different climate factors that must be considered in civil operations, building constructions and building designs. The most significant climate factors are as follows: weather temperature, soil temperature, angle and intensity of sunlight, relative humidity, direction and wind speed, rainfall and sunlight. Climate factors cannot be reduced in these items. Rather barometric pressure and such are also considered as climate factors but they don't play a big part in designing and civil operations. Besides, the

changes of some climate parameters are not high over the year so it does not make a big difference knowing about their time changes. Now, we'll be dealing with each of these factors.

### **Weather Temperature**

Perhaps weather temperature is the most important climate factor affecting climate designing. The intended dimensions in designing various points of a building and also the material in use are determined by the maximum and the minimum temperature of the region. Therefore, the quantity and quality for constructing a building are different depending on the type of the region: tropical, cold and moderate. Glacial region would require taking special decisions on the choice of materials. In order to prevent energy dissipation in tropical and cold regions in summer and winter time, body insulation of the buildings must be considered whereas this issue might not be of priority in moderate regions.

### **Soil Temperature**

Soil temperature and its changes are of importance over the year. The soil surface experiences the most changeability of temperature during the year which is caused by proximity with air and its changes. The more we go to the depth of the soil, the less changes of temperature we have so that in a specific depth called depth or attenuation depth temperature, annual changes of soil temperature is caused. Given the fact that building foundation lies in the soil, knowing about soil temperature, especially glacial soil and its depth, is of high significance in the selection of the materials and determining the foundation of a building. Moreover, knowing about the depth of glacial soil can be effective in the installation of gas, water... pipes. The depth of glacial soil is a point where the soil does not freeze in the coldest time of the year. It is clear that in cold regions the depth of installing such equipment must be lower than the depth of glacial soil so that they become immune of any frozen state. In order to know about the depth of glacial soil in any region, one shall refer to long-term climate data provided by meteorological stations. Now that the question of constructing urban common tunnels is around, this issue's importance is doubled.

### **Sunshine**

The rate of receiving sunshine is a function of several factors which include: latitude (angle of sunshine), the amount of cloud, and sunshine hours. The less the latitude, the less the angle of the stretch of sunshine with the vertical line to horizon and the more the receiving sunshine. Sunshine hour is irrelevant with the amount of cloud, when one increases the other decreases. In areas where the rate of receiving sunshine by the earth surface is high, temperature is high too. If the goal is to reduce the amount of sunshine entering the earth surface (this method has recently been noticed by climatologists and it is one of the strategies for reducing global warming and earth engineering), we can use reflexive mirrors.

### **Relative Humidity**

By definition, relative humidity refers to the proportion of the existing amount of humidity in the air to the maximum amount of acceptable humidity in terms of percent. The more the rate of relative humidity, the more the possibility for the formation of water drops on physical objects on the earth surface (including buildings and other constructions such as bridges, streets, etc.). This means the acceleration of the effect of humidity on equipment and their rust chemically (corrosion of metals, oxidation of metals, etc.) and physically (freezing water and causing crack in building design. In the regions where there is more relative humidity of weather such as coastal areas and islands, designing and construction of the buildings take place according to high adverse effects of water. They must be designed and constructed in a way that physical and chemical adverse effects of water decrease to the minimum level or even zero. This need is met through the selection of water and corrosion-resist materials and equipment.

### **Wind Direction and Speed**

Wind direction is a way from which it is blowing. Knowing about the wind direction of each region, bearing the most frequency from that direction (prevailing wind), is an important factor in setting the direction of building construction aerodynamically so that in the state of heavy winds, light buildings wouldn't be hit. In ancient times, in order to design the direction of wind wards especially in tropical regions (Yazd and Kerman), the length of wind ward vents was built in the direction of prevailing wind so that wind could be used in the best way possible to cool the building.

Wind speed is also important because in the case of high speed winds, there is the possibility for the detachment and physical damage to different parts of building especially light ones. Knowing about the mean of wind speed at the project site and seasonal and annual distribution of wind speed are important factors for strengthening against wind power. The more the mean of wind speed in the region, the more powerful the building must be.

In projects where there are several choices in terms of region, it is a good idea to pick up the one in which wind speed is lower than other regions. These regions are identified through wind pattern plans and measuring wind speed in different points of a region. If the goal is to use wind power such as establishing wind power plants, the place of the construction shall be chosen in a way that there is high-speed wind

around. It is clear that, in this case, permanent high-speed wind for most of the year or even all the year is an upward.

#### **Rain Fall**

The amount of rainfall is one of the most determining factors that shall be considered in building design, especially ceiling design. In rain areas, the ceiling of buildings must be designed as gable roof so that water erosion is reduced, due damages are minimized and there would be no water left on the roof. Otherwise, adverse effects of rain and its penetration into buildings would rise.

Knowing about the rate of rainfall, especially for designing structures like dams (estimation of the maximum probable rainfall) is necessary so we can determine spillway dimension, etc. moreover, in order to design surface water disposal system across cities when it rains, knowing about the maximum urban flood relevant to return period sounds like essential.

#### **Weather Detrimental Phenomena**

It refers to so high or so low rate of meteorological factors. For instance, flood or draught shows very high or low rate of rainfall. What matters about weather detrimental phenomena in civil operations is so high rates of meteorological factors. For example, concerning rainfall, its high rate which is flood or heavy showers is important and draught is unimportant. High warm and cold waves happening recently in different parts of the world due to climate change are considered to be important disasters. Tsunami receives high attention in coastal areas and islands. Dust storm makes limitations in the areas prone to wind slide. Limit values of weather and climate factors also happen in local conditions which require local studies and must be analyzed before starting the project.

#### **Weather Forecast**

It is essential to know about weather conditions of some days ahead so that you can adjust civil operations and plan doing different steps of building operation. The most important example is to know about rainfall occurrence during working days ahead. Rainfall occurrence would challenge building operations especially in primary stages of the project and can even strand it. This limitation in later stages when building constructions take place indoor is by far reduced.

One of the important uses of meteorological forecast is about dam-building workshops. Heavy rainfall occurrence in lands above the dam can cause flood in the workshop site and damage the existing equipment and vehicles and even claim human lives. Forecasting the amount of rainfall in the upper land and estimating the potential amount of the time of flood discharge, one can inform the workshops appropriately and prevent financial loss and human death.

Wind forecast can also play a big role in doing civil operations and construction especially about sky scrape buildings. Wind speed goes up with height increase and the increase in wind speed is logarithmic. Working in heavy wind conditions especially in highlands would cause damage to equipment and personnel. That is why it matters.

Non-liquid rainfall such as snow, hail, etc. brings about their own special problem. Forecasting this condition beforehand would help us adjust civil operations and timing for days ahead.

It is worth noting that weather forecast is not always true and it can be different in terms of precision and correctness according to various conditions and factors. So, it is possible for weather forecast to go wrong. In this case, ceasing the administrative operations for a while would put the project off and cause financial loss. Considering risk management conditions, the amount of this potential financial loss comparing to the loss coming from weather detrimental conditions and also human loss is negligible. Of course, taking all scientific forecast principles, the total amount of forecast would reduce to less than 10% in a period. Again, compared to relative potential material damages, the total potential material loss is lower.

### **CONCLUSION**

Generally, weather and climate role in civil operation and building construction is of importance in respect to looking at the past climate with the goal of building design and forecasting weather condition in the future to adjust civil operations. Looking at the past climate, the outcome of all climate factors must be taken into account and focusing on only one or two climate factors is by no means enough for all factors are significant though they have different weights. In the discussion of weather forecast which covers predicting a range of less than 10 days, damaging limit events (high-low damage) is important since they play a part in setting civil operations. It is necessary to note that weather forecast is not immune of error. Each forecast's precision rate depends on different factors including forecast term, the accuracy of prediction model, changes of map patterns during different days and the precision of individual predictor. In our country weather forecast is done by the state's meteorological organization freely. But in other countries, private companies or individuals do it in return for money. Therefore, they take responsibility for what they forecast.

Given what mentioned here, it is important and essential to pay enough attention to both past climate and weather forecast in the future for civil operations. Although the administrators of small and big civil projects pay a general attention to these points, it seems that civil engineers shall take the first step to institutionalized these information and shape this cooperation with the help of meteorologists.

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#### Citation of this article

Sarieh Zareaian, Khaled Aziz Zadeh. The Role of Climate Factors on Designing and Constructing Buildings (From Urbanization Architecture Approach). Bull. Env. Pharmacol. Life Sci., Vol 3 (1) December 2013: 197-200